

**Projected Population of the State of North Carolina and Its Counties
July 1, 2019 through July 1, 2039**

Technical Documentation

Demographic & Economic Analysis Section
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Introduction

This document provides an overview of the methods used to prepare population projections for the State of North Carolina and its 100 counties. The North Carolina Office of State Budget and Management (OSBM) released the latest set of population projections on November 15, 2019. These population projections replace those produced by this office in December of 2018. These population projections incorporate recent trends in fertility, mortality and net migration. OSBM produced population projections for the state and all 100 counties for each year from 2019 through 2039.

Summaries of these projections are available on the [OSBM website](#). In addition, end users may download three different datafiles. Two of the datafiles include the 2000-2009 intercensal estimates and the 2010-2018 revised and standard estimates produced by this office in September of 2019, as well as the 2019-2039 population projections. The third file includes only the 2010-2018 population estimates and the 2019-2039 population projections. These datafiles differ in the demographic characteristics presented. The three datafiles include:

- (1) estimates and projections of the population for each year by sex and single years of age;
- (2) estimates and projections of the population for each year and by sex, 5 categories of race (American Indian/Alaska Native, Asian & Pacific Islander, Black, White and Other) and broad age groups; and
- (3) estimates and projections of the population for each year from 2010 through 2039 by sex, Hispanic origin and race (White and non-White).

Methodology

Understanding Population Change: The Demographic Balancing Equation

The demographic balancing equation has two main component processes of population change – natural increase (or decrease) and net migration. Natural increase (or decrease) is the change that occurs as a result of the difference between births and deaths. Natural increase occurs when births to a population exceed deaths within that same population.

Net migration is the difference between the number of in-migrants and out-migrants. A population growing as a result of migration, will show positive net migration (more in-migrants than out-migrants). Migrants include both migrants to and from other countries (international migration) and domestic migrants (those moving to and from other states and counties). In context of population change at the county level, any permanent move from one county to another (or from another country) is considered migration.

This demographic equation is useful in understanding population change and in developing methods for estimating or projecting population or for estimating the components of population change. Demographers use a variety of methods to project population, including those described here (Murdock et al. 2006; Murdock and Ellis 1992; Siegel 2002; Smith, Tayman, and Swanson 2002).

Projection Model

The current population projection model OSBM uses includes two main components: a forecast model to project total population and population of each major race and Hispanic origin group and a cohort component method to model the projected changes in the age characteristics of the population.

First, OSBM projected the total household population for each of the 100 counties in North Carolina using time-series forecasting models that pattern future population change based upon historical trends in population for each county. For the current set of projections, the office selected a forecast model for each county that most accurately projected the 2010 Census and subsequent (2010-2018) county population estimates. Projections were selected that had low predicted errors [measured in terms of Mean Absolute Percentage Error (MAPE)] for each county using 1990-2018 data. OSBM then added the group quarters population to the projected household population for each county to obtain the projected total population for each county for each year from 2019 through 2039. The summation of these projected total populations for each county yielded the projected total population by year for the state of North Carolina.

After preparing projections of the total population for all counties and the state, OSBM projected the population of each sex and race group and each sex and Hispanic origin group combination using time-series forecast models. The resulting projections by sex, race, and Hispanic origin were then controlled to the projections of the total population for each county. The office then summed these sex, race and Hispanic origin population projections for each county and year to obtain the sex, race and Hispanic origin population projections for the state.

Cohort-Component

Race/Sex/Age characteristics

OSBM used a cohort component technique to project the age characteristics of each sex and race combination. Estimated survival rates for each age, sex and race combination are based on data from the previous two decennial censuses (2000 and 2010) and assume OSBM assumed these survival rates remain the same throughout the projection period with adjustments to account for actual deaths that occurred between 2010 and 2018. OSBM applied these survival rates to the population for each group at the beginning of each period to project the survived population for the subsequent year (the population assuming no net migration). Subtracting the survived population for the following year from the population as projected by the time-series forecasting models (described above), we obtained the estimated total net migration. OSBM adjusted this total net migration for each county for each year for age specific rates of net migration by using net migration trends by age from the previous decade (2000-2010). The resulting net migration by age for each sex and race group added to the survived population by age, sex and race yielded the final projected population by age; the process was repeated for the next period. The final step was to add the population at the

youngest age by applying the most recent race specific birth rates by race for the female population age 10 to 49.

Data

Historic Population

The most fundamental part of any population projection are the historical data from which the projections are derived. The decennial census serves as a basis for the population estimates and projections produced by this office, especially the 2000 and 2010 decennial censuses.

OSBM obtained 2000 and 2010 decennial census population by race, sex, and single years of age from 0-99 and a combined age group for population age 100+ from the Modified Age, Race, and Sex (MARS) file. The race categories used in these projections include: American Indian or Alaska Native, Asian and Pacific Islander, Black, White and Two or More Races. Hispanic origin is reported separately in these projections and is further categorized as White or non-White within Hispanic or non-Hispanic origin.

The base population estimates from the U.S. Census Bureau incorporated corrections to the 2010 Census count as a result of the Count Question Resolution (CQR) program. The CQR correction included a major change in the group quarters population for Durham and Granville County (the population of several prison facilities were incorrectly counted in Granville County rather than Durham County in 2010).

The certified and revised county population estimates produced by the Office of State Budget and Management and released in September 2019 were also used within the projection model.¹¹

Vital Statistics

The North Carolina State Center for Health Statistics provided vital statistics data for the years 2000 through 2018, which include recorded births and deaths by county of residence. OSBM used the data to calculate mortality and fertility rates and derive estimates of net migration for counties for the 2000 to 2010 period.

Group Quarters

Every year, OSBM obtains group quarters population counts for hundreds of facilities within the state from various federal and state agencies, as well as through an annual survey of municipalities and counties. These group quarters include, among other facilities, college and university dormitories, state and federal prisons, military quarters, and nursing homes. Because demographic change for group quarters population do not follow the same pattern as the general population, it is necessary to account for this population by excluding it from the general projection model and then adding it back to obtain the final projections of the total population. For the purpose of producing projections, OSBM assumed that the group quarters

¹ *Certified Estimates of the Total Population of North Carolina Counties for July 1, 2018 and Revised Estimates of the Total Population and Population by Age, Sex, Race, and Hispanic Origin of North Carolina Counties for 2010 through 2017.*

population for each county for all future years remained the same as it was in 2018².

Assumptions

Population estimates are prepared to approximate the population size and other characteristics of an area for historical periods when no census count of the population is available. Similarly, population projections are prepared to approximate the population size and other characteristics of an area for future periods. Both population estimates and population projections rely on historical data that are symptomatic of population change to approximate historical or future population but the population projections also rely on a set of assumptions to approximate future populations or characteristics of those populations. Any deviation from these assumptions will have implications for future populations. These assumptions assume continuation of historical patterns of change in total population or rates of fertility, mortality and net migration.

Total Population Change

As described above, the forecast model uses historical data to project total population and total population by sex, race, and Hispanic origin through 2039. These projections assume that historical trends in population change will continue.

Fertility

The precipitous decline in fertility rates that began during the Great Recession has halted and fertility rates have remained stable, but at a rate much lower than in the 1990s and early 2000s. These population projections assume fertility rates remain constant through the projection period, and use a three-year (2016, 2017, and 2018) average of age and race specific fertility rates. The projections use actual births for the historical period through 2018.

The projections also assume a constant distribution of births into male and female for each race group through the projection period. Additionally, the projections assume the fraction of female (or male) projected births for each age group to be the average of the corresponding fractions for calendar years 2008 through 2018.

Mortality

Following the 2010 Census, OSBM prepared an unabridged lifetable for 2010. The office assumed survival rates from this life table remain constant through the projection period but adjusted the rates to account for actual deaths that occurred through 2018.

Net Migration

The forecast model uses historical data to project total population and total population by sex and race through 2039. OSBM derived net migration from the fertility and mortality assumptions and from the methods as outlined in the cohort-component methods as described

²This is based partly on information provided by major sources of groups quarters populations including prisons (North Carolina Sentencing and Policy Advisory Commission), military installations, and college and universities.

above.

Adjustments

Institutional Effects

OSBM modified the basic county trend projections produced for this series to account for change in certain institutions, such as colleges, universities, military installations, and, to a lesser extent, prisons and some state hospitals, house persons of specific age groups. These populations change primarily as a function of administrative action. There are twelve counties in North Carolina with age structures significantly affected by institutions. These counties, and the major institution types that affects them, are: Avery (prisons and college), Craven (military), Cumberland (military), Durham (university), Jackson (university), Madison (university), New Hanover (university), Onslow (military), Orange (university), Pasquotank (university and prisons), Pitt (university), and Watauga (university). OSBM adjusted the projections to account for institutional populations, and assumed again that the institutional population would stay constant at 2017 levels.

Projection Controls

The initial set of population projections projecting total population for 2010 through 2018 were controlled to the independently derived estimates of the total population for counties. The projections were controlled to the revised estimates for 2010 through 2017 and for the certified estimates for 2018.

The estimates and projections of the population by race, sex and Hispanic origin of each county were then controlled to the estimates and projections of the total population of each county for the estimation/projection period (2010 through 2039).

Citations

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Smith, Stanley K., Jeff Tayman, and David A. Swanson. 2002. *State and Local Population Projections: Methodology and Analysis*. New York: Kluwer Academic/Plenum Publishers.